Course Acronym:	ATEC
Course Number:	22A
Descriptive Title:	Introduction to Engine Performance, Electrical and Fuel Systems
Division:	Industry and Technology
Department:	Automotive Technology
Course Disciplines:	Automotive Technology
Catalog Description:	This is an introductory engine performance course, which covers construction and operation of the following systems: computer controlled engine management, electrical charging, cooling, emission controls, fuel, and ignition. Laboratory activities stress the proper use of modern test equipment and repair procedures used in the automotive field. *Note: This course is equivalent to the two-course sequence Automotive Technology 23 and 24. Students who have completed Automotive Technology 23 and 24 will not receive credit for Automotive Technology 22A.*
Prerequisite:	
Co-requisite:	
Recommended Preparation:	Automotive Technology 1 or equivalent
Enrollment Limitation:	
Hours Lecture (per week):	5
Hours Laboratory (per week):	10
Outside Study Hours:	10
Total Course Hours:	270
Course Units:	8
Grading Method:	Letter Grade only
Credit Status:	Credit, degree applicable
Transfer CSU:	Yes
Effective Date:	Prior to July 1992
Transfer UC:	No
Effective Date:	
General Education: ECC	
Term:	
Other:	

CSU GE:	
Term:	
Other:	
IGETC:	
Term:	
Other:	
Student Learning Outcomes:	**SLO #1 Safety Exam** Given an in class exam, based on readings, classroom discussions and demonstrations, the student will be able to work in the Automotive Shop safely and pass the Automotive Safety Exam with 100% accuracy. **SLO #2 Engine Analysis** The student will perform an analysis of an engine using the Automotive Compression/ Cylinder Leakage Test/ Vacuum Testing lab worksheet to manufacturer specifications. **SLO #3 Engine Condition & Performance** The student will test and evaluate engine condition and performance using an Engine Analyzer/ Scanner lab worksheet to manufacturer specifications. **SLO #4 Fuel System Test** The student will be able to test the performance of an automotive fuel system using the Fuel System Performance Testing lab worksheet and manufacturer specifications.
Course Objectives:	1. Score 100% accuracy on a safety test. 2. Identify engine components. 3. Perform an analysis of an engine condition by conducting compression, cylinder leakage, and vacuum tests. 4. Measure and adjust valve lash. 5. Evaluate, service, test, and repair cooling systems. 6. Evaluate, service, and test lead-acid batteries. 7. Evaluate, service, test, and repair starting systems. 8. Evaluate, service, test, and repair charging systems. 9. Test, evaluate, and repair electrical circuits. 10. Identify ignition components. 11. Service, test, evaluate, and repair ignition systems. 12. Test and evaluate engine condition and performance using an engine analyzer/scanner. 13. Identify ignition scope patterns. 14. Evaluate, service, test, and repair fuel systems. 15. Evaluate, service, test, and repair emission control systems.
Major Topics:	**I. Course Overview and Safety (2.5 hours, lecture)** A. Safety information and test 1. Course requirements 2. Online Safety and Pollution Prevention training

(S/P2)
3. Shop policies

B. Personal Protective Equipment (PPE)
C. Shop and environmental hazards
   1. Commonly used shop chemicals
   2. Safety Data Sheets (SDS)
   3. Tool and shop equipment hazards
D. Proper hand/power tool and shop equipment identification and usage
E. Vehicle hoist operation
F. Service information accessing procedure
   1. Published repair procedures and specifications
G. Repair orders
   1. Proper procedures and legal guidelines
   2. Department of Consumer Affairs, Bureau of Automotive Repair (BAR) - "Write It Right"
   3. Purpose and workflow process
H. Technician training and certifications

II. Tools and Safety (5 hours, lab)

A. PPE usage
B. Shop safety rules demonstration
   1. Proper hand tool identification and usage
   2. Shop equipment identification and usage
C. Safe work area maintenance
   1. In-shop vehicle handling
   2. Proper in-shop engine emissions venting
   3. Safe vehicle hoisting
   4. Clean up procedures
D. Automotive Service Excellence (ASE) technician certification process A-1 through A-8 lab sheet
E. Properly complete vehicle repair work order
F. Introduction to a Digital Volt-Ohmmeter (DVOM), Volt/Amperage Tester (VAT) and a Digital Storage Oscilloscope (DSO)

III. Engine Design and Operation (8 hours, lecture)

A. Basic engine construction and engine performance
B. Cooling, fuel, and air induction systems
C. Introduction to ignition systems
   1. Distributor ignition systems
   2. Distributorless ignition systems
D. Introduction to emission control systems
   1. Exhaust Gas Recirculation (EGR)
   2. Positive Crankcase Ventilation (PCV)
   3. Catalytic converter
   4. Evaporative emissions control systems
   5. Secondary Air Injection
E. Differences between On Board Diagnostics Generation One (OBD I) and Generation Two (OBD II)

IV. General Engine Condition Diagnosis (18 hours, lab)

A. General diagnostic procedure
    1. Accessing service information
    2. Diagnostic flow charts
    3. Fixing it right the first time
B. Diagnosing fuel, engine oil and coolant leaks
C. Diagnosing engine exhaust odor, color, and noise
D. Engine overheating problems
    1. Pressure test the cooling system
E. Diagnosing engine defects
    1. Intake manifold vacuum readings
    2. Engine power balance test
    3. Engine compression test
    4. Cylinder leakage test
F. Performing valve adjustments on mechanical and hydraulic lifters

V. Distributor Ignition (12 hours, lecture)

A. Major functions of the ignition system
B. Operating conditions that affect ignition timing
C. Basic operation of distributor ignition systems and distributorless ignition systems
    1. Ignition primary circuit
    2. Ignition secondary circuit
    3. Ignition dwell
    4. Ignition triggering devices
    5. Spark timing systems

D. Engine position sensors
E. Spark plug internal design
    1. Hot and cold range spark plugs

VI. Distributor Ignition System Diagnosis and Service (20 hours, lab)

A. Visual inspection and testing of ignition system components
    1. Ignition system troubleshooting using an oscilloscope
    2. Primary and secondary circuit trace pattern
    3. Cranking output test
    4. Spark duration
    5. Coil polarity
    6. Secondary resistance
    7. Spark plug load
    8. Ignition system testing using a voltmeter, ohmmeter and test light
B. Spark plug Removal and Replacement (R&R)
C. Ignition timing testing and setting procedure
D. Ignition spark advance evaluation

VII. Electronic Ignition (EI) Systems (7.5 hours, lecture)

A. Purpose of the electronic control unit
B. Spark timing systems
    1. Electronic switching systems
    2. Engine position sensors
C. Fuel injection system reliance

D. Distributorless EI systems
    1. Advantages and operation
    2. Secondary ignition wiring connections
    3. Fast-start systems
E. Coil-On-Plug (COP) operating principles
F. Ion and compression sense ignition

VIII. EI Diagnosis and Service (16 hours, lab)

A. No-start condition diagnosis
B. Coil testing
C. Camshaft and crankshaft sensor R&R and adjustment procedure
D. Camshaft and crankshaft sensor test
E. Magnetic sensor test
    1. Pickup coil (magnetic pulse generator)
    2. Hall-effect switch
F. Compression sense ignition diagnosis
G. Ion sense ignition diagnosis

IX. Fuel Systems (10 hours, lecture)

A. Performance characteristics of gasoline
    1. Octane ratings
    2. Various types of gasoline and additives
    3. Comparisons with different alternative fuels, including diesel
B. Principles of operation of a fuel injection system
    1. Advantages of fuel injection
C. Differences between Direct Fuel Injection (DFI) and Port Fuel Injection (PFI) systems
D. Difference between a Sequential Fuel Injection (SFI) system and a Multiport Fuel Injection (MFI) system
E. Design and function of major Electronic Fuel Injection (EFI) components
F. Fuel tank design, mounting, fuel tank filler, and filler cap design
G. Types of fuel lines and fuel line fittings
H. Fuel filter designs and mountings
I. Electric fuel pump operation
    1. Relief valve and check valve
    2. Pulse Width Modulated (PWM) fuel pump systems
    3. Purpose of the inertia switch in a fuel pump circuit
J. Purpose of the fuel pressure sensor in direct fuel injection systems
K. Direct fuel injection basic operation

X. Fuel System Diagnosis and Service (20 hours, lab)

A. Fuel system visual inspection
B. Fuel alcohol content testing
C. Fuel system pressure relief procedure
D. Fuel tank inspection and service
E. Electric fuel pump assembly R&R, inspection and service
F. Fuel line and tubing inspection and service
G. R&R fuel filter

H. Electric fuel pump testing and service
    1. Electric fuel pump pressure and volume output test
    2. PWM fuel system description and operation

XI. Electronic Fuel Injection (10 hours, lecture)

A. Principles of operation of a fuel injection system
B. DFI fuel systems
C. Purpose of Variable valve timing and an Intake Manifold Tuning Valve (IMTV)
D. Design and function of EFI systems
    1. Computer corrected air-fuel ratio operational mode comparisons
E. Pressure regulator operation
    1. Returnless EFI system
    2. Two-way return type system
F. Central injector and poppet nozzles operation in a Central Port Injection (CPI) system
G. Idle Air Control (IAC)l bypass air motor operation of the Throttle Actuator Control (TAC) system

XII. Electronic Fuel Injection Diagnosis and Service (21.5 hours, lab)

A. Fuel injection system preliminary diagnostic procedure
B. Throttle body assembly removal, inspection, cleaning and installation
C. Incorrect fuel pressure analysis
D. Injector balance test
    1. Determine injector condition
    2. Clean injectors
E. Injector sound, ohmmeter, and noid light test
F. Fuel pump check valve and pressure regulator valve leakage check
G. R&R fuel rail, injectors, and fuel pressure regulator
H. Improper idle speed cause identification
    1. IAC Motor diagnosis
    2. Idle air control bypass air motor diagnosis
    3. Remove, replace, and clean idle air control bypass air motors and related throttle body passages
    4. Idle air control bypass air valve testing and analysis

XIII. Engine Control Input Sensors (7.5 hours, lecture)

A. Analog and digital voltage signals identification and analysis
B. Computer input signals
    1. Binary coding
C. Oxygen and Air-Fuel ratio (A/F) sensor design and operation
D. Engine Coolant Temperature (ECT) sensor
E. Intake air temperature sensor operation and description
F. Throttle Position Sensor (TPS) design and operation
    1. TPS sensor circuitry and wiring
G. Types of Mass Air Flow (MAF) sensors
H. Manifold Absolute Pressure sensor
I. Knock sensors
J. Purpose of the EGR valve position sensor

K. Vehicle speed sensor signal - role and relevance

XIV. Engine Control System Diagnosis and Service (16 hours, lab)

A. Diagnostic trouble code retrieval, analysis and erasure
B. Scan tool usage exercises
    1. Perform a continuous self-test
    2. Perform a scan tester diagnosis on various vehicles
C. Cylinder output test
D. Computer voltage supply and ground wire testing and analysis
E. Switch-type input sensors testing and diagnosis
F. Diagnosis and testing exercises
    1. Engine coolant temperature sensors
    2. Intake air temperature sensors
    3. Exhaust gas recirculation valve position sensors
    4. Oxygen sensors
    5. Knock sensors
    6. Vehicle speed sensors
    7. MAP sensors
    8. MAF sensors

XV. Computer Outputs (7.5 hours, lecture)

A. High-side and low-side drivers definition and description
    1. Computer driven output actuator operation
    2. Quad drivers and output driver modules
    3. Duty cycle
    4. PWM
B. Output driver roles
    1. Fuel injector operation
    2. IAC system operation
    3. EGR valve operation
C. Computer output control of electronic ignition spark timing

XVI. Computer Output Diagnosis and Service (16 hours, lab)

A. High-side and low-side computer driver circuit diagnosis
B. Computer output actuators diagnosis
C. Fuel injector output driver diagnosis
D. Computer controlled IAC system problem diagnosis
E. Computer operated EGR valve identification and description

XVII. Emission Control Systems (10 hours, lecture)

A. Federal emission standards
    1. Clean Air Act of 1990
    2. Federal vehicle emission ratings
B. California emission standards
    1. California Air Resources Board (CARB)
    2. California vehicle emission ratings
C. Smog-producing emissions
    1. Hydrocarbon (HC) emission production process

2. Carbon monoxide (CO) emission production process
3. Oxides of Nitrogen (NO_x) production process

D. Exhaust oxygen content production process
1. Relationship to air/fuel ratio
E. Carbon Dioxide production process
F. Evaporative emissions control system operation and purpose
1. Canister purge and non-purge modes
G. PCV system operation and purpose
1. PCV operating conditions
H. Knock sensor and electronic spark control module purpose and operation
I. EGR valves
1. Differential Pressure Feedback EGR (DPFE) valve
2. Digital EGR valve
3. Linear EGR valve
J. EGR system controls
K. Catalytic converter construction, purpose and operation
L. Secondary Air Injection System (AIR)
M. On-Board Refueling Vapor Recovery (ORVR) purpose and operation

XVIII. Emission Control System Diagnosis and Service (21.5 hours, lab)

A. Differing state vehicle emissions Inspection/Maintenance (I/M) control programs identification and description
B. Evaporative Emissions (EVAP) system diagnosis and service
C. Canister purge valve testing
D. PCV system part inspection and replacement
E. Improper EGR operation diagnosis and service
1. Identify and service different EGR valves and control solenoids
F. Catalytic converter efficiency check
G. Diagnose and service secondary air injection systems

XIX. OBD II and Computer Systems (7.5 hours, lecture)

A. Primary provisions of OBD II
1. Requirements to illuminate the Malfunction Indicator Light (MIL)
B. OBD II system monitors and enable criteria
1. OBD II warm-up cycle
2. Trip and drive cycle
3. Continuous and non-continuous monitors
4. Comprehensive Component Monitor (CCM)
C. Engine misfire detection
1. Type A and type B misfires
D. Catalyst monitoring
1. Purpose of two oxygen sensors in an exhaust system
E. Five mandates in OBD II
F. Purpose of Random-Access Memory (RAM) and Read-Only Memory (ROM)
1. Volatile and nonvolatile memory
G. Diagnostic trouble code numbering and types

XX. OBD II System Diagnosis and Service (16 hours, lab)

A. OBD II system preliminary checks
B. OBD II system problem diagnosis

	C. Scan tool diagnostic usage D. Troubleshooting 1. Symptom chart 2. Diagnostic flow chart E. OBD II diagnostics definitions F. Illuminated MIL, Diagnostic Trouble Codes (DTCs) 1. Root cause identification 2. Basic format description G. OBD II system components monitoring H. Diagnosing intermittent problems I. OBD II circuit repair **XXI. Networks and Networking (7.5 hours, lecture)** A. Vehicle computer networking 1. Serial data bus 2. Multiplexing B. UART, J1850, KWP2000, and ISO 9141 communications 1. Peer-to-peer communication 2. Master-to-slave communication C. Controller Area Network (CAN) operation D. Types of vehicle module wiring configurations E. Network module function and Powertrain Control Module (PCM) relationship **XXII. Servicing Networks (10 hours, lab)** A. Vehicle network module function diagnosis B. Serial data bus interpretation 1. Network electrical schematics 2. Schematic circuit and component identification 3. Multiplexing process description C. Networking speeds and method retrieval D. CAN, network wiring, and peer-to-peer/master-to-slave communication observation and analysis E. Network module list and identification F. Anti-theft systems G. CAN Bus testing and diagnosis 1. Manufacturer specific procedures and protocols H. Replace and reprogram network module procedure description
Total Lecture Hours:	90
Total Laboratory Hours:	180
Total Hours:	270
Primary Method of Evaluation:	3) Skills demonstration
Typical Assignment Using Primary Method of Evaluation:	Working from memory, sketch a drawing of a complete emission control system. Submit drawing to the instructor.

Critical Thinking Assignment 1:	Perform a vehicle fuel system inspection and performance test and record data on a fuel system lab sheet. Analyze data using manufacturer's specifications to determine recommended service and/or repairs and parts required. Record recommended repairs on a lab report and submit to the instructor.
Critical Thinking Assignment 2:	Perform a four gas exhaust test to include a data print out. Analyze data using manufacturer's specifications to determine adjustments and/or recommended repairs to include parts required. Record recommended repairs on a lab report and submit to the instructor.
Other Evaluation Methods:	Performance exams Other exams Quizzes Written homework Laboratory reports Class Performance Homework Problems Multiple Choice Completion Matching Items True/False Other: COMPLIANCE WITH MANUFACTURER'S SERVICE PROCEDURES
Instructional Methods:	Demonstration Discussion Group Activities Guest Speakers Internet Presentation/Resources Laboratory Lecture Multimedia presentations
If other:	Collaborative learning
Work Outside of Class:	Study Answer questions Required reading Problem solving activities Written work
If Other:	
Up-To-Date Representative Textbooks:	James D. Halderman, Automotive Electrical and Engine Performance, 8th edition, Prentice Hall, 2020.
Alternative Textbooks:	Shop manuals
Required Supplementary Readings:	Three ring binder notebook and paper Pen and pencil Safety glasses Shop safe clothing

	Tools (optional) Lab sheets Procedure sheets
Other Required Materials:	
Requisite:	
Category:	
Requisite course(s): List both prerequisites and corequisites in this box.	
Requisite and Matching skill(s):Bold the requisite skill. List the corresponding course objective under each skill(s).	
Requisite Skill:	
Requisite Skill and Matching Skill(s): Bold the requisite skill(s). If applicable	
Requisite course:	Automotive Technology 1
Requisite and Matching skill(s):Bold the requisite skill. List the corresponding course objective under each skill(s).	**Work safely in the automotive shop.** ATEC 1 - Complete a safety test with 100% accuracy. **Safe use of automotive hand tools.** ATEC 1 - Select and use proper tools.
Requisite Skill:	or equivalent
Requisite Skill and Matching skill(s): Bold the requisite skill. List the corresponding course objective under each skill(s). If applicable	If students have not taken Automotive Technology 1 but have taken a similar course at another college or have basic automotive work experience, students will have the skills needed to take this course. It is highly recommended that students have basic automotive skills to enhance their success in this course.
Enrollment Limitations and Category:	
Enrollment Limitations Impact:	
Course Created by:	Robert E. Beaudoin
Date:	02/25/1985

Original Board Approval Date:	
Last Reviewed and/or Revised by:	Michael Anderson
Date:	05/03/2022
Last Board Approval Date:	11/21/2022